California Environmental Protection Agency

AIR RESOURCES BOARD

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STANDARD OPERATING PROCEDURES

FOR

ANDERSEN INSTRUMENTS

POLY-URETHANE FOAM (PUF) SAMPLER - SPECIAL

AQSB SOP 800

First Edition

MONITORING AND LABORATORY DIVISION

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California Environmental Protection Agency
AIR RESOURCES BOARD

Approval of Standard Operating Procedures (SOP)

Title:	**ANDERSEN INSTRUMENTS** **POLY-URETHANE FOAM (PUF) SAMPLER - SPECIAL**
SOP:	AQSB SOP 800, First Edition
Section:	Operation Support Section
Branch:	Air Quality Surveillance Branch (AQSB)
Division:	Monitoring and Laboratory Division (MLD)
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Operation Support Section
Air Quality Surveillance Branch

_____ _____
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Air Quality Surveillance Branch

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Poly-Urethane Foam (PUF) Sampler - Special

1.0 GENERAL INFORMATION

1.1 Introduction:

This document provides the standard operating procedures (SOPs) for the use of the Andersen Polyurethane Foam (PUF) Sampler-Special for collecting ambient air samples of polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs).

1.2 Purpose:

The purpose of this SOP is to provide field operators with guidance to ensure that air samples are appropriately collected, stored and shipped. The procedures described in this document are based on the guidelines provided in U.S. EPA Method TO-9A.

Program specific requirements and modifications to these standard operating procedures in this document should be documented separately in each program's sampling protocol or field operations procedure.

1.3 Abbreviations:

PCBs – polychlorinated biphenyls

PCDDs – polychlorinated dibenzo-p-dioxins

PCDFs – polychlorinated dibenzofurans

PUF – polyurethane foam

QFF – quartz fiber filter

1.4 Principle of Operation:

Dioxin samples are collected using the Thermo Andersen PUF Sampler-Special. The sample consists of a sampling head (Figure 2) which is designed to hold a circular 4-inch-diameter quartz-fiber filter (QFF) and a 2.5-inch-diameter by 5-inch-long cylindrical glass sample cartridge containing a 3-inch polyurethane foam (PUF) sorbent trap that fits snugly into the cartridge. Particulates in the sample stream are collected on the filter, while any vapors that pass through the filter are collected by the PUF sorbent.

Some samplers may be configured with the "Connecticut" option. This

configuration differs only in that the size and shape of the quartz-fiber filter which is an 8 inch by 10 inch rectangular filter. The motor, flow controller, and other components are the same as the standard configuration.

The Thermo Andersen Polyurethane Foam Sampler-Special, Operator Manual contains a significant source of information pertinent to the operation, maintenance and understanding of this instrument. The ARB highly recommends a thorough review of the operation manual prior to installation and operation.

1.5 Physical Descriptions:

The sampler consists of a sampling head, a mass flow controller (a temperature differential sensor and a feed back control circuit), and a vacuum blower (motor). The mass flow controller controls the sample flow rate by increasing or decreasing the motor speed by adjusting the input voltage to the motor. The sampler is activated and deactivated via the use of a seven-day timer. The number of hours that the sampler operates is recorded by an elapsed time meter.

Figure 1. Thermo Andersen PUF Sampler.

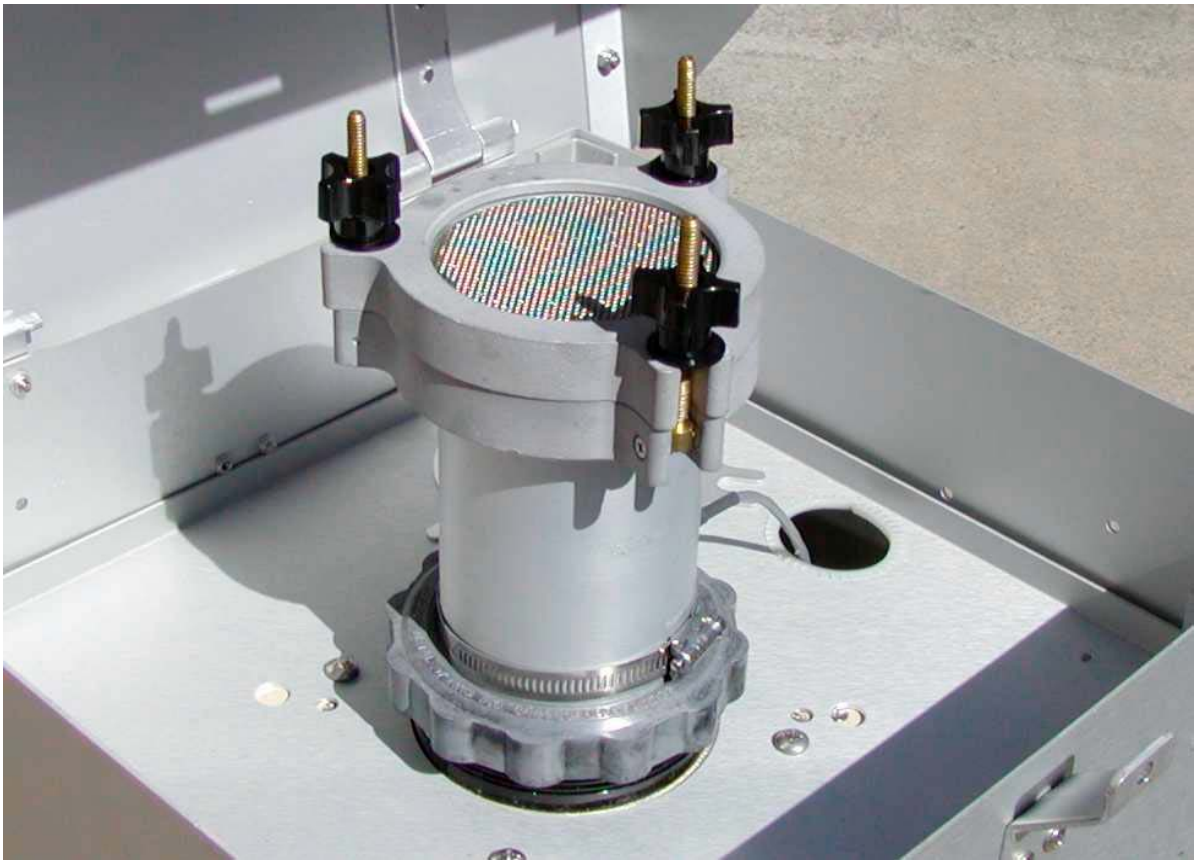

Figure 2. TO-9a Sampling Head.

2.0 INSTALLATION PROCEDURE

2.1 Installation Instructions:

The Andersen PUF sampler is complete and should not require any major assembly. Prior to installation, an effort to comply with all of the siting requirements of 40 CFR Part 58 should be made.

1. Remove the PUF sampler from the shipping carton.

2. Assemble the filter holder onto the motor.

3. Secure the unit so the wind will not blow it over.

4. Set the day and time on the mechanical timer.

5. Calibrate the sampler according to the instructions in Section 5, Calibration Procedures.

6. An electrical source of 110 volts, 15 amps is required.

2.2 Cautions:

Only personnel familiar with the operation of the sample should perform installation, operation, maintenance or calibration procedures. As with all monitoring equipment, precautions should be taken when working around electricity, power tools and above ground elevations.

1. To avoid sample contamination, be sure to wear disposable non-powered latex gloves and use forceps while handling the PUF and QFF. Gloves and disposable forceps will be discarded after each use.

2. The QFF is delicate and easily damaged. Handle carefully by the edges.

3. The analytical detection limit is in the range of 0.2 picograms per cubic meter of air.

4. Do not clean sampler with anything other than a lint free cloth.

5. To avoid electrical shock, disconnect the 110 VAC power before working on the motor.

6. The PUF contains dioxin, furan and PCB standards at very low levels and should be handled with caution. Under normal operating procedures the PUF will never be touched directly and latex gloves will always be used when handling the glass cartridges.

3.0 SAMPLING PROCEDURE

3.1 Sampling Frequency and Duration:

The samplers will be operated on a frequency and duration specified in each project's sampling protocol or field operations procedure. The typical sampling duration according to EPA Method TO-9A is 24 hours for sampling 325-400 m^3 of ambient air.

3.2 Initial Procedure:

Prior to the start of initial sampling, the sampler should be properly calibrated in accordance with the procedures in the section 5, Calibration Procedures. Complete the Field Data Sheet (Appendix A) by entering the site information, sample and blank ID information, sample calibration information, start and stop times, magnehelic readings, and elapsed meter reading. Record the initial ambient temperature, and barometric pressure.

3.3 Loading the Sampler:

Load the cylindrical glass PUF cartridge and the QFF into the sampling head as follows:

1. Open the top cover and front access door to the sampler. Unscrew the filter holder assembly portion of the sampling head.

2. While wearing non-powdered latex gloves, remove a PUF cartridge from its shipping container and remove any foil wrapping from the PUF cartridge. The used foil should be discarded.

3. Load the PUF cartridge into the sampling head with the screen towards the bottom. **The PUF cartridge should have an o-ring in the groove near the open end of the cartridge. If the o-ring is missing, one should be installed.** Reattach the filter holder assembly to the sampling head.

4. Loosen the three thumbscrews on the top of the filter assembly and remove the protective plate and retaining rings. While still wearing the gloves, use the forceps provided to place a teflon gasket onto the filter support screen. Place a clean QFF over the lower teflon gasket and another teflon gasket on top of the QFF. Reinstall the filter retaining ring and tighten the thumbscrews. The protective plate may be stored away at this time.

5. Load a seven day Dickson chart into the Dickson recorder. Set the recorder to the current date and time.

6. Manually turn on the sampler and allow it to run for at least five minutes. After five minutes, adjust the sampler magnehelic to the calibrated set-point and record the initial magnehelic reading on the data sheet. Annotate the sampler's indicated 240 slpm mark on the dickson chart.

7. Set the mechanical timer to turn on and off according to the schedule specified by each program's sampling protocol. The correct time and programmed START and STOP times are set as follows:

   a. To set the current time and day, grasp the dial and rotate clockwise only until the correct time and day appear at the pointer.

   b. Set the START time by attaching a (bright) "ON" tripper to the dial face on the desired START time.

   c. Set the STOP time by attaching a (dark) "OFF" tripper to the dial face on the desired STOP time.

8. Load a seven day dickson chart into the dickson recorder. Set the recorder to the current date and time.

For a more detailed description of loading the PUF sampler, refer to the specific program protocol and the Thermo Andersen manual.

3.4 Sample Recovery:

1. At the end of the desired sampling period, make sure the power is turned off. Manually turn on the sampler and allow it to run for at least five minutes. Record the ending magnehelic reading on the field data sheet.

2. Loosen the three thumbscrews on the top of the filter holder assembly. While wearing disposable, non-powdered latex gloves, use the forceps provided to remove the exposed QFF from the sampling head. Place the exposed QFF into the shipping jar or petri dish.

3. Remove the PUF cartridge from the samplers downtube. Remove the o-ring from the glass cartridge and set it aside for future use. Wrap the PUF cartridge in the solvent rinsed foil.

4. Complete the field sample report (Appendix A). Ship and store the exposed sampling media to the analytical lab in a container capable of maintaining a temperature of four degrees Celsius or lower.

5. Perform a leak check, if required for monthly maintenance checks (refer to Section 5.2).

6. Reassemble filter holder assembly and cover plate to sampler.

4.0 CALIBRATION INFORMATION

4.1 Introduction:

The purpose of this section is to outline the Thermo Andersen Instruments PUF Samplers-Special calibration procedures used by the Monitoring and Laboratory Division of the California Air Resources Board (ARB).

The Thermo Andersen Instrument's Operation Manual is an important resource of information for calibrations, and therefore the ARB highly recommends a thorough review of the Operation Manual.

4.2 Apparatus for PUF Sampler Calibration:

In order to calibrate the PUF sampler, it is necessary to obtain the following equipment:

1. Andersen Model G40 Calibration Kit containing:
    - Slack tube manometer or digital manometer
    - NIST Traceable Calibration Orifice
2. NIST traceable pressure sensor
3. NIST traceable temperature sensor
4. Calibration forms or laptop computer

Calibration of the PUF sampler equipped with the Connecticut option requires a PM10 adapter plate along with a NIST traceable orifice and a calibrated slack tube manometer.

4.3 Notes:

To best simulate the actual operating conditions under which the sampler runs, all calibrations are performed with dummy PUF cartridge and with a dummy QFF loaded in the sampler.

5.0 CALIBRATION PROCEDURES

5.1 Overview:

The Thermo Andersen PUF Sampler-Special, is calibrated using an orifice transfer standard that has been standardized against a primary standard Roots meter. The orifice transfer standard is referenced to 25° C and 760 mm Hg. The calibrator is connected to a differential pressure gauge or slack tube manometer. Pressure drops and indicated flow meter readings are recorded and corrected for elevation, as necessary. Using the pressure drops, the standard (true) flow rates are calculated using the certification equation for the transfer standard. Finally, a working sampler calibration curve of standard flowrate vs. indicated flowrate is plotted. The field calibration procedure assumes that:

1. Elevations below 1,000 feet are equivalent to standard conditions.

2. The effect of temperature on the indicated flow rate is negligible.

5.2 Leak Check:

This test should be conducted after sampler assembly, after motor maintenance, and before flow calibrations and verifications. **The leak check should be performed without any sampling media installed in the sampler.** The following procedures should be followed:

1. Disconnect the motor from the mechanical timer and connect it to the variable DC power supply.

2. Remove the PUF cartridge and the QFF if necessary.

3. Place the cover plate over the inlet opening and secure with the thumbscrews.

4. Energize the sampler. A leak-free system will also indicate no response on the magnehelic. Leaks are usually caused by either a missing gasket at the junction of the orifice and sampling head or loose thumbscrews.

Do not run the sampler longer than 30 seconds with a plugged calibration orifice or the motor will overheat and cause damage to the motor.

5. Turn off the sampler and remove the cover plate.

6. If the PUF sampler is leak free, proceed to calibration of the sampler.

5.3 Flow Rate Calibration Of The Magnehelic Gage:

The following is a step-by-step procedure for the calibration of Thermo Andersen Mass Flow Controlled PUF Sampler. These instructions pertain to the samplers that have airflow controlled by mass flow controllers (MFC) in conjunction with a continuous flow recorder or differential pressure gauge.

The basic sampler calibration procedure relates known flow rates, as determined by a calibrated transfer standard orifice, to the pressure differential at the exit of the blower housing. This pressure differential is referred to as the plenum pressure, where the plenum is the region within the motor housing where the pressure level exceeds atmospheric pressure.

The mass flow controller will sense a change in airflow and appropriately adjust the voltage to the brushless motor that compensates the airflow rate to the nominal airflow setting. This flow control is necessary to maintain acceptable airflow range of the PUF sampler. The recommended nominal flow rate setting of the PUF sampler is 240 standard liters per minute (slpm).

To calibrate the magnehelic gage, the orifice and manometer is installed to the inlet of the sampler. Manometer pressure drops (Δ H's) and magnehelic readings (Δ P's) are recorded and a relationship is established between Δ H and Δ P. This relationship becomes the calibration curve for the calibration.

The following steps detail the procedure for calibrating the Andersen PUF Sampler:

1. Record the site information, sampler information, ambient temperature and barometric pressure on the calibration data sheet (Appendix B).

2. Disconnect the motor form the mechanical timer and connect it to the variable DC power supply.

3. Load a dummy PUF cartridge and a dummy QFF sandwiched between teflon gaskets into the sampler. Attach the calibration orifice to the sampling head. Attach the slack tube manometer or digital manometer to the tap on the calibration orifice and check that the tubing connectors on the manometer are open.

4. Turn on the motor allowing it to warm up for at least five minutes.

5. Calculate the Δ H you should observe to achieve a standard flow rate (Qs) of 240 slpm, by using the Qs equation on the orifice certification report.

6. Adjust the motor speed so that the slack tube manometer reads the calculated Δ H. Record Δ H from the slack tube manometer or digital manometer and the corresponding magnehelic reading Δ P on the calibration data sheet.

7. Repeat step 6 for two manometer readings above 240 slpm and two manometer readings below 240 slpm. Appropriate calibrations points are as follows:

   calculated Δ H + 0.5 inch H2O

   calculated Δ H + 1.0 inch H2O

   calculated Δ H – 0.5 inch H2O

   calculated Δ H – 1.0 inch H2O

8. Use the Δ H and corresponding Δ P values to generate a linear regression between the manometer reading and the magnehelic reading. This calculation is done automatically by the PUF calibration form (Appendix B).

9. Turn off the sampler and reconnect the motor to the mechanical timer.

10. Adjust the sampler flow to the magnehelic reading that corresponds to 240 slpm.

11. Perform a flow verification to verify the calculated set-point flow rate. See Section 6.3 Flow Verification of this document.

6.0 VERIFICATION PROCEDURES

6.1 Introduction

Verification procedures are quality control practices implemented by Air Quality Surveillance Branch. These practices are designed to ensure that the samplers post calibration set point has been calculated properly and that the samplers flow rate has not drifted between sampling moments.

6.2 Calibration Flow Verification

Calibration flow verifications should be performed after sampler calibrations to ensure the calculated magnehelic set point is accurate. With a calibration PUF cartridge and QFF installed, perform the calibration flow verification as follows:

1. Attach the calibration orifice to the filter holder assembly. The upper filter retaining ring should not be installed on the sampler. Attach the slack tube manometer or digital manometer to the tap on the calibration orifice and check that the tubing connectors on the manometer are open.

2. Turn on the sampler and allow it to warm up for 5 minutes. Adjust the sampler to the calibrated 240 slpm set point.

3. Record the manometer reading and calculate the flow in slpm. Verify that the sampler flowrate 240 +/- 24 slpm (216 to 264 LPM). If the flow is not in the specified range, check for leaks, improper sample media and or other problems that may be present. If no leaks or other problems are present recalibrate the sampler.

6.3 Sampling Flow Rate Check:

The sampling flow rate check is performed to ensure the sampler, when set to the proper calibrated set point operates at 240 slpm. Sample flow rate checks should be performed using an actual sample PUF w/XAD cartridge and a dummy QFF. Flow rate checks should be performed prior installation of a new sample moment. Sample flow rates should be conducted as follows:

1. Remove the filter holder assembly from the sample head.

2. Install sample PUF w/XAD and a dummy QFF and teflon rings into the sampler (refer to section 3.3 Loading the Sampler paragraphs 2 - 4). However do not install upper filter holder retaining ring.

3. Attach the calibration orifice to the filter holder assembly. Attach the slack

tube manometer or digital manometer to the tap on the calibration orifice and check that the tubing connectors on the manometer are open.

4. Turn on the sampler and allow it to warm up for 5 minutes. Adjust the sampler to the calibrated 240 slpm set point.

5. Record the manometer reading and calculate the sampler flow rate in slpm. Record the sampler's magnehelic reading. Verify that the sampler flowrate 240 +/- 24 slpm (216 to 264 slpm). Record flow check values on the field data sheet. If the flow is not in the specified range, check for leaks, improper sample media and or other problems that may be present. If no leaks or other problems are present recalibrate the sampler.

7.0 ROUTINE SERVICE CHECKS

7.1 General Information:

Perform the following service checks according to the procedures documented in this section. Routine service checks may be performed more frequently, but should be performed at least at the prescribed intervals. Also attached is a copy of the Field Sample Report (Appendix A), which you should complete for each run. Forward field sample reports monthly to your supervisor.

7.2 Monthly Checks:

Perform a leak check and flow verification as outlined in the sections 5 and 6 of this document. Clean the screen on the bottom of the motor housing with a stiff wire brush.

7.3 Semi-Annual Checks:

Every six months perform a flow calibration of the magnehelic gage.

8.0 MAINTENANCE

8.1 General Information:

The Thermo Andersen PUF Sampler-Special utilizes a brushless motor to drive the sampler's airflow. This type of motor does not require any routine maintenance or brush changes.

8.2 PUF Sampler Maintenance:

Perform a flow calibration twice a year or anytime the motor, timer, or variable DC power supply is changed or altered. Clean the screen on the bottom of the motor housing every month using a stiff wire brush.

8.3 Clean Flow Probe:

The mass flow controller probe sensor should be checked for dust accumulation. If the probe sensor gets contaminated by dust accumulation, it should be cleaned by taking the following steps:

1. Disconnect all power plugs from the unit.

2. Remove the flow probe.

3. Clean with water using a camel hair brush.

4. Clean again with alcohol.

5. Reinstall the flow probe. When reinstalling, make sure the probe is properly aligned. Make sure the groove along the probe faces upwards.

6. Perform a flow verification after reinstalling the probe. If necessary, perform a flow calibration.

9.0 TROUBLESHOOTING

Refer to Table 1 for a list of symptoms and recommended corrective action to attempt. Additional troubleshooting information can be found in the Andersen PUF operators manual.

TABLE 1- TROUBLESHOOTING

SYMPTOM	**CORRECTION**
1. Is the sampler's flow running Too high or too low?	a. Make sure PUF and QFF are in place. Check QFF loading. b. Make sure the probe is installed correctly. c. Clean the probe. d. Perform a leak check and correct any leaks.
2. Does the sampler's flow oscillate?	a. Make sure the QFF and PUF are in place. If there is no QFF, the system oscillates because the time constant of electronics is slower than the change in mass flow rate.
3. Cannot get full mass flow rate?	a. Check QFF loading. b. Check motor by bypassing the mass flow controller. If motor is faulty, replace.
4. Unit does not come on at all?	a. Check to see if the transformer primary or secondary leads have broken loose. If so, re-solder or replace transformer. b. Check the timer.

CARB FIELD SAMPLE REPORT
Poly-Urethane Foam (PUF) Samplers

Site Name: _____ Month/Year: _____

AIRS Site Number: _____ PUF Sampler I.D. #: _____

Field Technician: _____ PUF Field Blank I.D. #: _____

Agency: _____ QFF Sample I.D. #'s: _____

Sampler Property #: _____ QFF Field Blank I.D. #: _____

		Date	Time	Amb. Temp.	Amb. Press.	Mag Read	Elapsed Meter
Sample Event	Start						
(Install PUF/QFF)	Stop						

OPERATOR INSTRUCTIONS:

1. Change QFF.
   Record sample information.
   Verify sample flow rate.

2. Verify Sampler Flow Rate:

Orifice S/N#: _____

Manometer Reading: _____

Flow Rate: _____

Mag. Reading: _____

3. Semi-Annual: Calibrate sampler Date Last Calibrated: _____

Magnehelic Set Point: _____

Magnehelic vs. Standard Flow (Qs) Equation: Qs = (_____) X Mag Reading + (_____)

Comments:	

Appendix A.

ARB Calibration Report - Andersen Polyurethane Foam (PUF) Sampler

Calibration Summary

ID Information:

Station Name:	Oakland-Fruitvale	Make:	Andersen	As Is:	XX
Site AIRS No:		Model:	GPS1V1-313HBL	Final:	
Station Address:	6701 Internat'l Blvd.	Property B/C:	20020911	Cal Date:	09/25/2002
Agency:	ARB			Last Cal Date:	05/08/2002

Calibration Info:

Transfer Standard ID:

Make & Model:	Andersen G40LP
Barcode No:	20020876
Serial No:	1458
Cert Date:	11/15/2001
Cert Expires:	11/15/2002

Meteorology:

Amb Temp (deg C):	19
Amb Temp (deg K):	292
Amb Press (mmHg):	753
Elevation (ft):	25

Slope and Intercept:

	Standard Flow(Qs):
m=	9.3694
b=	-0.130666

Calibration Results:

Actual values		**Calibration values**		
Manometer Delta H	Magnehelic Delta P	True Std Flow Qstd in scm	Observed Std Flow Qstd in scm	% Difference From True Qstd
3.8	1.8	0.2232	0.2251	0.8919
4.3	2.0	0.2365	0.2352	-0.5621
4.7	2.2	0.2466	0.2452	-0.5804
5.1	2.4	0.2563	0.2552	-0.4335
5.4	2.6	0.2633	0.2652	0.7144

Regression Results (Delta P vs True Std Flow):

Std Flow Qs= **Slope (M3) * (mag reading) + intercept (B3)**

Slope (M3)=	0.0501
Intercept (B3)=	0.1350
R Squared (CC2):	0.9877

Calculated Set Point: 2.1 (at 0.24 m3/min.)

T/P Factor: 1.0111

Verification: mag= 2.1 man= 4.6

Comments:	

Calibrated by: **Reviewed by:**

Appendix B.